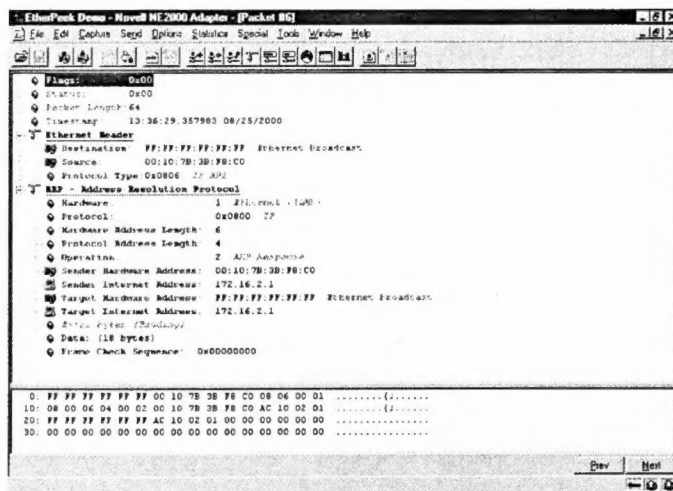
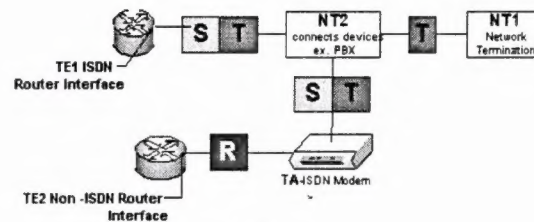


\$299.00

Cisco Internetwork Troubleshooting Supplement

Additional reference for CIT / Support CCNP exam (instructor led course)



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T/S Model and Fault Isolation Methods

Methods of Fault Isolation:

- Outside-in
- Inside-out
- Divide by half

T/S Model Steps:

- Define the problem
- Gather Facts
- Consider Possibilities
- Create an Action Plan
- Implement Action Plan
- Observe Results
- Document Solution and Facts

Typical Troubleshooting Commands for Router / Switch - read more details from the book

Show controllers Ethernet [interface number]	To display statistics like missing datagrams, memory errors, buffer errors, and overflow errors for an Ethernet interface on a Cisco router (Please note this command will not give you information on internal hardware errors)
Show flash	To display the router images stored in NVRAM
Show buffers	To display statistics for the buffer pools in router (Please note that the router has one pool of queuing elements and five pools of packet buffers of different sizes. Network server keeps counts of the number of buffers outstanding, the number of buffers in the free list, and the maximum number of buffers allowed in the free list for each pool)
Show processes	To display information about the active processes in a router
Show tech-support	To show tech support router conditions
Show version	To show current status of router
Debug ip rip	To check if RIP routing is operating properly
Show ip route	To display the entries in the routing table
Show version	To obtain a router's firmware version
Show running-config	To obtain a router's current configuration
Show interface fddi 3/0	To display an upstream neighbor value of 0000 0000 0000 for FDDI (Keep in mind that 0000 0000 0000 means the upstream neighbor is unknown, indicating that a physical problem is likely to have occurred)
Debug isdn	To troubleshoot ISDN BRI layer 2 and 3

q921 / debug isdn q931	
Show controller bri	To view information specifically about the D channel of a BRI line
Logging console level	To send debugging output to the consol
Show frame- relay	To obtain statistics about a PVC (Permanent Virtual Circuit) on all Frame Relay interfaces

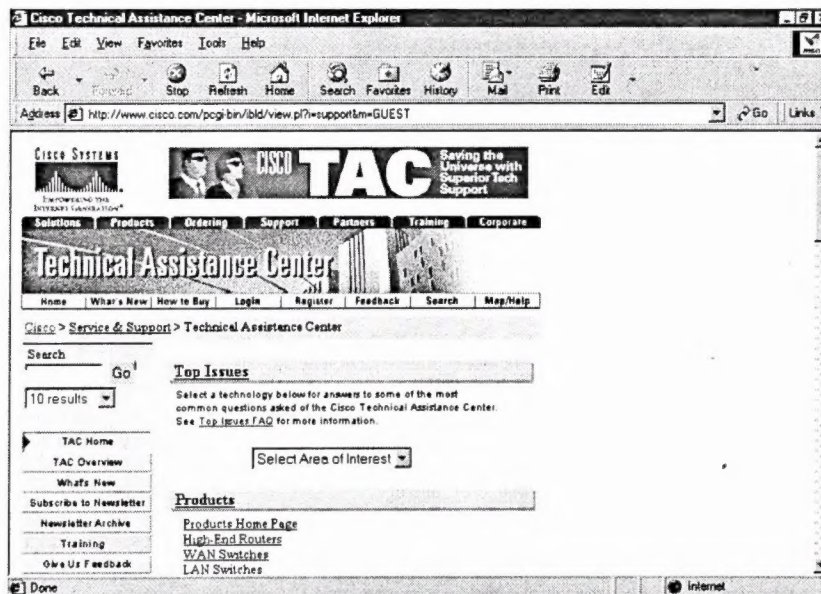
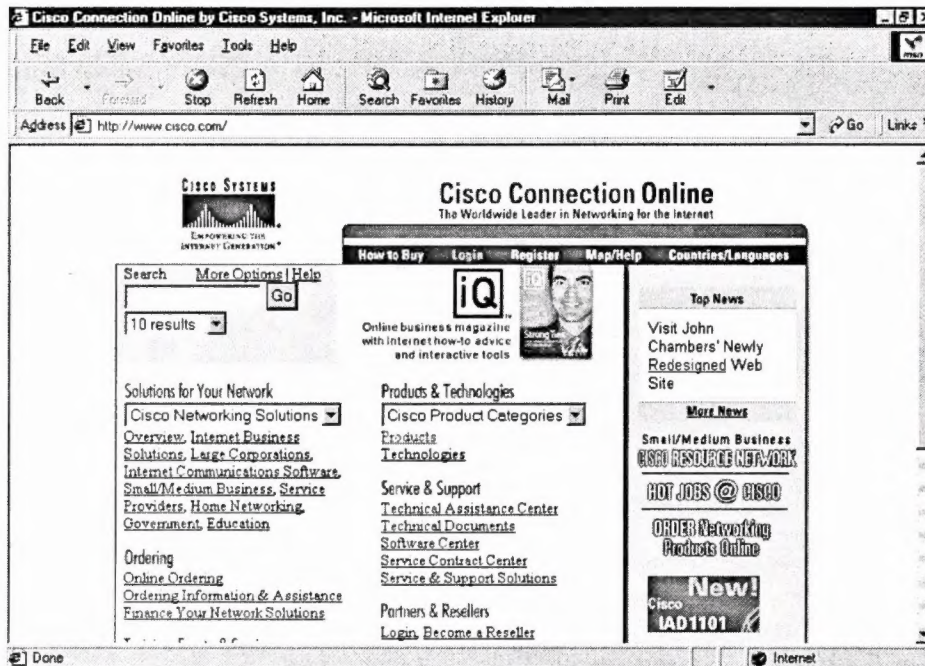
Other commands

- The "trace" command works by using an error message generated by routers when a datagram exceeds its time-to-live value. It displays the router round-trip time for each probe.
- The "service timestamps" command puts a date and time in the log in order to tell how much time has elapsed between events.

Troubleshooting Tools

Break out boxes / BERTS (Bit Rate Error Testers) / Fox boxes	Troubleshoot peripheral interfaces by monitoring data line conditions, analyzing and trapping data, and diagnosing problems common to data communication systems
Volt Ohm meter	Measures the physical properties including current, resistance, capacitance, and cable continuity
Cable tester	Checks physical connectivity on STP, UTP, 10BaseT, coaxial, and a special cable type called twinax-cable
Time Domain Reflectors	Troubleshoots crimps, kinks, impedance, bends, and other defects in metallic cables by measuring how much time it takes the signal to reflect and calculating the distance to a fault
Optical Time Domain Reflectors	Troubleshoots optical cable
Network Monitors	Determines a baseline and establish trends in the networks
Network Analyzer	Decodes the various layers in a frame and presents them as summaries detailing which layer is involved
TrafficDirector	Collects RMON information
Stack Decoder	Pastes in the output of a "Show stack" command after an error. The stack decoder tool will provide meaningful comments in the stack trace
Protocol analyzers	Display packet data
CCO bug toolkit resources	Bug Navigator, Bug Alert and Bug Watcher
NetSYS	Simulates network changes in a virtual environment
Cisco website	The site has a technical database, an open question-and-answer forum, a mailing-list archive, a troubleshooting assistant, a software bug toolkit, accesspath configuration

	tools, an IP subnet calculator, a stack decoder, a 3600 memory calculator, TAC Case instructions, and Cisco products for purchase online
CiscoWorks	Internetwork management software that works with SNMP. It can monitor devices for environmental and interface statistics, display information about the health of a device, view data similar to the output of a "show exec" command, display and analyze the path between two devices, probe and extract data about the condition of the network, dynamically monitor and troubleshoot using graphs of device statistics and comprehensive configuration information, gather historical data for analysis, and create detailed maps which you can provide to CiscoTAC for assistance in debugging your network
CiscoTrafficDirector	Remote monitoring tools to gather data, monitor activity on your network and find potential problems, and allows users to monitor all seven layers of the OSI model
VLAN Director	Provides an accurate representation of the physical network, has the capability to find discrepancy on conflicting ports, can quick detect changes in VLAN status and switch ports, and has user authentication and write protection security
Troubleshooting Engine	Provides simulations of failures and allows users to test possible solutions (CSEs (Customer Support Engineers) often connect to the Troubleshooting Engine to network hardware in the TAC (Technical Assistance Center) lab)



Cisco Technical Assistance Center - Microsoft Internet Explorer

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Basic Troubleshooting Tools & Commands

4 of the most basic T/S tools are:

show version, show run, show cdp neighbors, and show tech-support

```
cisco2#show version
Cisco Internetwork Operating System Software
IOS (tm) 1600 Software (C1600-Y-L), Version 11.1(12)AA, EARLY
DEPLOYMENT RELEASE SOFTWARE (fc1)
Copyright (c) 1986-1997 by cisco Systems, Inc.
Compiled Mon 09-Jun-97 14:20 by krunyan
Image text-base: 0x0801A214, data-base: 0x02005000

ROM: System Bootstrap, Version 11.1(10)AA, EARLY DEPLOYMENT RELEASE
SOFTWARE (fc1)
ROM: 1600 Software (C1600-BOOT-R), Version 11.1(10)AA, EARLY DEPLOYMENT
RELEASE SOFTWARE (fc1)
```

```
cisco2 uptime is 3 minutes
System restarted by reload
System image file is "flash:c1600-y-1.111-12.AA", booted via flash
```

```
cisco 1601 (68360) processor (revision C) with 1536K/512K bytes of
memory.
Processor board ID 11943000
Bridging software.
X.25 software, Version 2.0, NET2, BFE and GOSIP compliant.
1 Ethernet/IEEE 802.3 interface.
1 Serial(sync/async) network interface.
System/IO memory with parity disabled
2048K bytes of DRAM onboard
System running from FLASH
8K bytes of non-volatile configuration memory.
4096K bytes of processor board PCMCIA flash (Read ONLY)
```

Configuration register is 0x2102

```
cisco2#
cisco2#
```

```
router1#
router1#show running-config
Building configuration...
```

Current configuration:

```
!
version 11.2
no service udp-small-servers
no service tcp-small-servers
!
hostname router1
!
enable secret 5 $1$wgkP$I68COYt3xL9sTiuJNOmCJO
enable password 12345
```



```

!
!
interface Loopback0
 ip address 172.16.1.1 255.255.255.0
!
interface Loopback1
 ip address 172.16.2.1 255.255.255.0
!
interface Ethernet0
 no ip address
 shutdown
!
interface Serial0
 ip address 172.16.3.1 255.255.255.0
!
router ospf 10
 network 172.16.1.1 0.0.0.0 area 0
 network 172.16.2.1 0.0.0.0 area 0
 network 172.16.3.1 0.0.0.0 area 0
!
no ip classless
!
line con 0
line vty 0 4
 password 12345
 login
!
end

```

cisco5#sh cdp neighbors

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater

Device ID	Local Intrfce	Holdtme	Capability	Platform
Port ID				
Cisco6	Eth 0	161	R	2500
0				

Cisco5#

cisco5#sh cdp neighbors detail

Device ID: cisco6

Entry address(es):

IP address: 132.42.1.1

Platform: cisco 2500, Capabilities: Router

Interface: Ethernet0, Port ID (outgoing port): Ethernet0

Holdtime : 151 sec

Version :

Cisco Internetwork Operating System Software

IOS (tm) 2500 Software (C2500-I-L), Version 11.2(3)P, SHARED PLATFORM,

RELEASE SOFTWARE (fc1)

Copyright (c) 1986-1996 by cisco Systems, Inc.

Compiled Tue 31-Dec-96 16:18 by tamb

cisco2# show tech-support

----- show version -----

Cisco Internetwork Operating System Software
 IOS (tm) 1600 Software (C1600-Y-L), Version 11.1(12)AA, EARLY
 DEPLOYMENT RELEASE SOFTWARE (fc1)
 Copyright (c) 1986-1997 by cisco Systems, Inc.
 Compiled Mon 09-Jun-97 14:20 by kruncan
 Image text-base: 0x0801A214, data-base: 0x02005000

ROM: System Bootstrap, Version 11.1(10)AA, EARLY DEPLOYMENT RELEASE
 SOFTWARE (fc1)
 ROM: 1600 Software (C1600-BOOT-R), Version 11.1(10)AA, EARLY DEPLOYMENT
 RELEASE SOFTWARE (fc1)

cisco2 uptime is 22 minutes
 System restarted by reload
 System image file is "flash:c1600-y-l.111-12.AA", booted via flash

cisco 1601 (68360) processor (revision C) with 1536K/512K bytes of
 memory.
 Processor board ID 11943000
 Bridging software.
 X.25 software, Version 2.0, NET2, BFE and GOSIP compliant.
 1 Ethernet/IEEE 802.3 interface.
 1 Serial(sync/async) network interface.
 System/IO memory with parity disabled
 2048K bytes of DRAM onboard
 System running from FLASH
 8K bytes of non-volatile configuration memory.
 4096K bytes of processor board PCMCIA flash (Read ONLY)

Configuration register is 0x2102

----- show running-config -----

Building configuration...

Current configuration:

```
!
version 11.1
service udp-small-servers
service tcp-small-servers
!
hostname cisco2
!
enable secret 5 <removed>
enable password <removed>
!
!
interface Ethernet0
 ip address 131.41.1.1 255.255.0.0
!
interface Serial0
 ip address 1.1.1.2 255.0.0.0
```



```

router rip
 network 131.41.0.0
 network 1.0.0.0
!
router igrp 1
 network 131.41.0.0
 network 1.0.0.0
!
no ip classless
snmp-server community <removed> RO
!
line con 0
line vty 0 4
 password <removed>
 login
!
end

```

----- **show controllers** -----

*control the "circuit"
analyze hardware inputs*

```

QUICC Ethernet unit 0 using SCC1, Microcode ver 4
Current station address 0050.7321.e130, default address 0050.7321.e130
idb at 0x2080338, driver data structure at 0x207DB64

```

SCC Registers:

```

General [GSMR]=0x0:0x1088003C, Protocol-specific [PSMR]=0x80A
Events [SCCE]=0x0000, Mask [SCCM]=0x001F, Status [SCCS]=0x0002
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0xD555

```

Interrupt Registers:

```

Config [CICR]=0x00368461, Pending [CIPR]=0x04004004
Mask [CIMR]=0xC8000012, In-srv [CISR]=0x00000000
Command register [CR]=0x600
Port A [PADIR]=0x0000, [PAPAR]=0xCCC3
      [PAODR]=0x0000, [PADAT]=0x35FE
Port B [PBDIR]=0x00F13E, [PBPAR]=0x0010CE
      [PBODR]=0x000000, [PBDAT]=0x0348DD
Port C [PCDIR]=0x0002, [PCPAR]=0x0008
      [PCSO]=0x0C30, [PCDAT]=0x03C4, [PCINT]=0x0000

```

SCC GENERAL PARAMETER RAM (at 0xFF00C00)

```

Rx BD Base [RBASE]=0x420, Fn Code [RFCR]=0x18
Tx BD Base [TBASE]=0x490, Fn Code [TFRCR]=0x18
Max Rx Buff Len [MRBLR]=1520
Rx State [RSTATE]=0x18000000, BD Ptr [RBPTR]=0x438
Tx State [TSTATE]=0x18000AE3, BD Ptr [TBPTR]=0x498

```

SCC ETHERNET PARAMETER RAM (at 0xFF00C30)

```

CRC Preset [C_PRES]=0xFFFFFFFF, Mask [C_MASK]=0xDEBB20E3
Errors: CRC [CRCEC]=0, Alignment [ALEC]=0, Discards [DISFC]=0
PAD Char [PADS]=0x0
Retry Limit [RET_LIM]=15, Count [RET_CNT]=15
Frame Lengths: [MAXFLR]=1518, [MINFLR]=64
Max DMA Lengths: [MAXD1]=1518, [MAXD2]=1518
Group Address Filter [GADDRn]=0000:0000:0020:0100
Indiv Address Filter [IADDRn]=0000:0000:0000:0000
Physical Address [PADDR1]=30E1.2173.5000
Last Address Set in Filter [TADDR]=CCCC.CC0C.0001
Persistence [P_Per]=0, Backoff Cnt [BOFF_CNT]=0

```

155

BD Pointers:

First Rx [RFBD]=0x0, First Tx [TFBD]=0x498, Last Tx [TLBD]=0x490

RX ring with 8 entries at 0xFF00420, Buffer size 1524

Rxhead = 0xFF00438 (3), Rxp = 0x207DB8C (3)

```
00 pak=0x20843CC buf=0x218FB0C status=9000 pak_size=0
01 pak=0x208421C buf=0x218F454 status=9000 pak_size=0
02 pak=0x208406C buf=0x218ED9C status=9000 pak_size=0
03 pak=0x2083D0C buf=0x218E02C status=9000 pak_size=0
04 pak=0x2083B5C buf=0x218D974 status=9000 pak_size=0
05 pak=0x20839AC buf=0x218D2BC status=9000 pak_size=0
06 pak=0x20837FC buf=0x218CC04 status=9000 pak_size=0
07 pak=0x208364C buf=0x218C54C status=B000 pak_size=0
```

TX ring with 4 entries at 0xFF00490, tx_count = 0

tx_head = 0xFF00498 (1), head_txp = 0x207DBE0 (1)

tx_tail = 0xFF00498 (1), tail_txp = 0x207DBE0 (1)

```
00 pak=0x0000000 buf=0x0000000 status=0000 pak_size=0
01 pak=0x0000000 buf=0x0000000 status=0000 pak_size=0
02 pak=0x0000000 buf=0x0000000 status=0000 pak_size=0
03 pak=0x0000000 buf=0x0000000 status=2000 pak_size=0
```

0 missed datagrams, 0 overruns

0 transmitter underruns, 0 excessive collisions

0 single collisions, 0 multiple collisions

0 dma memory errors, 0 CRC errors

0 alignment errors, 0 runts, 0 giants

QUICC SCC specific errors:

0 buffer errors, 0 overflow errors

0 input aborts on late collisions

0 heartbeat failures, 0 cumulative deferred

0 throttles, 0 enables

QUICC Serial unit 0

idb at 0x2084F9C, driver data structure at 0x2086CC0

SCC Registers:

General [GSMR]=0x2:0x00000030, Protocol-specific [PSMR]=0x0

Events [SCCE]=0x0000, Mask [SCCM]=0x001F, Status [SCCS]=0x0006

Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E

Interrupt Registers:

Config [CICR]=0x00368461, Pending [CIPR]=0x04004004

Mask [CIMR]=0xC8000012, In-srv [CISR]=0x00000000

Command register [CR]=0x600

Port A [PADIR]=0x0000, [PAPAR]=0xCCC3

[PAODR]=0x0000, [PADAT]=0xF7FE

Port B [PBDIR]=0x00F13E, [PBPAR]=0x0010CE

[PBODR]=0x000000, [PBDAT]=0x0348DD

Port C [PCDIR]=0x0002, [PCPAR]=0x0008

[PCSO]=0x0C30, [PCDAT]=0x03C4, [PCINT]=0x0000

DTE V.35 serial cable attached.

SCC GENERAL PARAMETER RAM (at 0xFF00F00)

Rx BD Base [RBASE]=0x580, Fn Code [RFCR]=0x18

Tx BD Base [TBASE]=0x5C0, Fn Code [TFRCR]=0x18

Max Rx Buff Len [MRBLR]=1524

Rx State [RSTATE]=0x18008240, BD Ptr [RBPTR]=0x580

Tx State [TSTATE]=0x18000348, BD Ptr [TBPTR]=0x5C0


```

SCC HDLC PARAMETER RAM (at 0xFF00F38)
CRC Preset [C_PRES]=0xFFFF, Mask [C_MASK]=0xF0B8
Errors: CRC [CRCEC]=0, Aborts [ABTSC]=0, Discards [DISFC]=0
Nonmatch Addr Cntr [NMARC]=0
Retry Count [RETRC]=0
Max Frame Length [MFLR]=1524
Rx Int Threshold [RFTHR]=0, Frame Cnt [RFCNT]=65312
User-defined Address 0000/0000/0000/0000
User-defined Address Mask 0x0000

```

```

buffer size 1524
BRGC1=101B0, BRGC2=0, BRGC3=0, BRGC4=0
modem_signal_addr FF01566
MASK: DSR=1, DTR=2, RTS=8, CTS=400, DCD=800
txbrgc=FF015FC, rxbrgc=FF015FC
BRG [DTE]: rx_sicr_clk=7, tx_sicr_clk=6
BRG [DCE]: rx_sicr_clk=7, tx_sicr_clk=3
CLK SRC: sync=4000, async=4000
RX ring with 8 entries at 0xFF00580, Buffer size 1524
Rxhead = 0xFF00588 (1), Rxp = 0x2086CE0 (1)
00 pak=0x208A48C buf=0x2195FE0 status=9000 pak_size=0
01 pak=0x208A7EC buf=0x2196D50 status=9000 pak_size=0
02 pak=0x208A12C buf=0x2195270 status=9000 pak_size=0
03 pak=0x2089F7C buf=0x2194BB8 status=9000 pak_size=0
04 pak=0x2089C1C buf=0x2193E48 status=9000 pak_size=0
05 pak=0x208A99C buf=0x2197408 status=9000 pak_size=0
06 pak=0x2089DCC buf=0x2194500 status=9000 pak_size=0
07 pak=0x208A63C buf=0x2196698 status=B000 pak_size=0

```

```

TX ring with 2 entries at 0xFF005C0, tx_count = 0
tx_head = 0xFF005C8 (1), head_txp = 0x2086D3C (1)
tx_tail = 0xFF005C8 (1), tail_txp = 0x2086D3C (1)
00 pak=0x0000000 buf=0x0000000 status=0000 pak_size=0
01 pak=0x0000000 buf=0x0000000 status=2000 pak_size=0
QUICC SCC specific errors:
0 input aborts on receiving flag sequence
0 throttles, 0 enables
0 overruns
0 transmitter underruns
0 transmitter CTS losts

```

----- **show stacks** -----

Minimum process stacks:

Free/Size	Name
880/1000	c1000 LED
2944/4000	Init
1436/2000	Router Init

Interrupt level stacks:

Level	Called	Unused/Size	Name
4	1894	2544/3000	CPIC interrupts
7	0	2980/3000	Programmable Interval Timer

----- show interfaces -----

```

Ethernet0 is up, line protocol is up
  Hardware is QUICC Ethernet, address is 0050.7321.e130 (bia
0050.7321.e130)
  Internet address is 131.41.1.1/16
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 255/255, load
1/255
  Encapsulation ARPA, loopback not set, keepalive set (10 sec)
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:04:37, output 00:00:02, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    75 packets input, 8434 bytes, 0 no buffer
    Received 70 broadcasts, 0 runts, 0 giants
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    0 input packets with dribble condition detected
    241 packets output, 21496 bytes, 0 underruns
    0 output errors, 0 collisions, 2 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out
Serial0 is up, line protocol is up
  Hardware is QUICC Serial
  Internet address is 1.1.1.2/8
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load
1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input 00:00:03, output 00:00:03, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/64/0 (size/threshold/drops)
    Conversations 0/2 (active/max active)
    Reserved Conversations 0/0 (allocated/max allocated)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    225 packets input, 13242 bytes, 0 no buffer
    Received 223 broadcasts, 0 runts, 0 giants
    2 input errors, 0 CRC, 2 frame, 0 overrun, 0 ignored, 0 abort
    236 packets output, 14595 bytes, 0 underruns
    0 output errors, 0 collisions, 4 interface resets
    0 output buffer failures, 0 output buffers swapped out
    2 carrier transitions
  DCD=up DSR=up DTR=up RTS=up CTS=up

```


----- **show buffers** -----

Buffer elements:
 500 in free list (500 max allowed)
 958 hits, 0 misses, 0 created

Public buffer pools:

Small buffers, 104 bytes (total 50, permanent 50):
 50 in free list (20 min, 150 max allowed)
 292 hits, 0 misses, 0 trims, 0 created
 0 failures (0 no memory)

Middle buffers, 600 bytes (total 25, permanent 25):
 25 in free list (10 min, 150 max allowed)
 207 hits, 0 misses, 0 trims, 0 created
 0 failures (0 no memory)

Big buffers, 1524 bytes (total 50, permanent 50):
 50 in free list (5 min, 150 max allowed)
 86 hits, 0 misses, 0 trims, 0 created
 0 failures (0 no memory)

VeryBig buffers, 4520 bytes (total 0, permanent 0):
 0 in free list (0 min, 100 max allowed)
 0 hits, 0 misses, 0 trims, 0 created
 0 failures (0 no memory)

Large buffers, 5024 bytes (total 0, permanent 0):
 0 in free list (0 min, 10 max allowed)
 0 hits, 0 misses, 0 trims, 0 created
 0 failures (0 no memory)

Huge buffers, 18024 bytes (total 0, permanent 0):
 0 in free list (0 min, 4 max allowed)
 0 hits, 0 misses, 0 trims, 0 created
 0 failures (0 no memory)

Interface buffer pools:

Ethernet0 buffers, 1524 bytes (total 28, permanent 28):
 13 in free list (0 min, 28 max allowed)
 15 hits, 0 fallbacks
 7 max cache size, 7 in cache

Serial0 buffers, 1524 bytes (total 16, permanent 16):
 4 in free list (0 min, 16 max allowed)
 60 hits, 0 fallbacks
 4 max cache size, 4 in cache

----- **show process memory** -----

Total: 1842340, Used: 795296, Free: 1047044

PID	TTY	Allocated	Freed	Holding	Getbufs	Retbufs	Process
0	0	24784	300	670964	0	0	*Init*
0	0	248	9296	248	0	0	*Sched*
0	0	852560	93504	164	189820	0	*Dead*
1	0	36104	25872	14804	0	0	RIP Router
2	0	0	0	2716	0	0	Check heaps
3	0	92	0	2808	0	0	Pool Manager
4	0	256	256	2716	0	0	Timers
5	0	92	0	2808	0	0	ARP Input
6	0	92	0	2808	0	0	SERIAL

A'detect

7	0	232	0	2948	0	0 Probe Input
8	0	92	0	2808	0	0 RARP Input
9	0	128	0	4844	0	0 IP Input
10	0	0	0	2716	0	0 TCP Timer
11	0	748	0	5464	0	0 TCP Protocols
12	0	2616	1712	3620	0	0 CDP Protocol
13	0	952	0	3668	0	0 BOOTP Server
14	0	0	0	2716	0	0 Asy FS Helper
15	0	172	0	4888	0	0 IP Background
16	0	0	0	2716	0	0 IP Cache Ager
17	0	128	0	2864	0	0 Critical Bkgnd
18	0	5524	0	2808	0	0 Net Background
19	0	92	0	4808	0	0 Logger
20	0	4972	256	2716	0	0 TTY Background
21	0	0	0	2716	0	0 Per-Second
Jobs						
22	0	0	0	2716	0	0 Net Periodic
23	0	184	0	2900	0	0 Net Input
24	0	0	284	2716	0	0 Per-minute
Jobs						
25	0	92	6632	2832	0	0 RIP Send
26	0	596	0	5312	0	0 IP SNMP
27	0	92	0	2808	0	0 SNMP Traps
28	0	0	0	2740	0	0 IP-RT
Background						
29	0	744	0	14688	0	0 IGRP Router
30	0	174944	173236	6140	0	0 Exec
				795188	Total	

----- show process cpu -----

CPU utilization for five seconds: 36%/10%; one minute: 16%; five minutes: 13%

PID	Runtime(ms)	Invoked	uSecs	5Sec	1Min	5Min	TTY	Process
1	1260	198	6363	0.00%	0.08%	0.06%	0	RIP Router
2	31984	299	106969	19.84%	3.45%	2.48%	0	Check heaps
3	0	1	0	0.00%	0.00%	0.00%	0	Pool Manager
4	0	2	0	0.00%	0.00%	0.00%	0	Timers
5	0	24	0	0.00%	0.00%	0.00%	0	ARP Input
6	4	1	4000	0.00%	0.00%	0.00%	0	SERIAL A'detect
7	0	1	0	0.00%	0.00%	0.00%	0	Probe Input
8	4	1	4000	0.00%	0.00%	0.00%	0	RARP Input
9	164	138	1188	0.00%	0.00%	0.00%	0	IP Input
10	0	272	0	0.00%	0.00%	0.00%	0	TCP Timer
11	0	1	0	0.00%	0.00%	0.00%	0	TCP Protocols
12	124	169	733	0.00%	0.00%	0.00%	0	CDP Protocol
13	4	1	4000	0.00%	0.00%	0.00%	0	BOOTP Server
14	0	1	0	0.00%	0.00%	0.00%	0	Asy FS Helper
15	2272	1375	1652	0.00%	0.01%	0.00%	0	IP Background
16	0	23	0	0.00%	0.00%	0.00%	0	IP Cache Ager
17	0	1	0	0.00%	0.00%	0.00%	0	Critical Bkgnd
18	12	4	3000	0.00%	0.00%	0.00%	0	Net Background
19	4	4	1000	0.00%	0.00%	0.00%	0	Logger
20	76	1352	56	0.00%	0.00%	0.00%	0	TTY Background
21	20	1353	14	0.00%	0.00%	0.00%	0	Per-Second Jobs
22	76	1353	56	0.08%	0.01%	0.00%	0	Net Periodic
23	64	164	390	0.00%	0.00%	0.00%	0	Net Input
24	880	23	38260	0.00%	0.05%	0.03%	0	Per-minute Jobs
25	152	99	1535	0.00%	0.00%	0.00%	0	RIP Send
26	4	2	2000	0.00%	0.00%	0.00%	0	IP SNMP
27	0	1	0	0.00%	0.00%	0.00%	0	SNMP Traps
28	36	24	1500	0.00%	0.00%	0.00%	0	IP-RT Background
29	460	39	11794	0.00%	0.03%	0.00%	0	IGRP Router
30	8372	612	13679	6.78%	3.52%	1.08%	0	Exec

Capturing Data with a Protocol Analyzer (EtherPeek)

EtherPeek Demo - Novell NE2000 Adapter - [Capture]

File Edit Capture Send Options Statistics Special Tools Window Help

Start Capture Initiate Send

Packet	Source	Destination	Size	Time-Stamp	Protocol	Plug-In Info
4	IP-172.16.2.1	00:10:7B:3B:F8:C0	64	13:36:29.355461	ARP Req	172.16.2.1 = ?
5	IP-172.16.2.1	Ethernet Broadcast	64	13:36:29.356916	ARP Rsp	00:10:7B:3B:F8:C0
6	IP-172.16.2.1	Ethernet Broadcast	64	13:36:29.357983	ARP Rsp	00:10:7B:3B:F8:C0
7	IP-172.16.2.1	Ethernet Broadcast	64	13:36:29.359201	ARP Rsp	00:10:7B:3B:F8:C0
8	IP-172.16.2.1	Ethernet Broadcast	64	13:36:29.360461	ARP Rsp	00:10:7B:3B:F8:C0
9	IP-172.16.2.1	Ethernet Broadcast	64	13:36:29.361680	ARP Rsp	00:10:7B:3B:F8:C0
10	00:10:7B:3B:F8:C0	00:10:7B:3B:F8:C0	64	13:36:29.780491	Loopback	
11	00:E0:B0:63:EC:4E	00:E0:B0:63:EC:4E	64	13:36:34.003970	Loopback	
12	00:50:73:21:DE:F5	00:50:73:21:DE:F5	64	13:36:35.480832	Loopback	
13	IP-172.16.2.1	IP Broadcast	90	13:36:39.624085	UDP RIP	
14	00:10:7B:3B:F8:C0	00:10:7B:3B:F8:C0	64	13:36:39.784610	Loopback	
15	00:10:7B:3B:F8:C0	01:00:0C:CC:CC:CC	304	13:36:40.426285	Discovery	
16	IP-172.16.4.1	IP Broadcast	90	13:36:41.173031	UDP RIP	
17	IP-172.16.3.1	IP-172.16.4.99	118	13:36:43.699312	PING Req	
18	IP-172.16.4.99	IP-172.16.3.1	118	13:36:43.700004	PING Rpl	
19	IP-172.16.3.1	IP-172.16.4.99	118	13:36:43.738511	PING Req	
20	IP-172.16.4.99	IP-172.16.3.1	118	13:36:43.739069	PING Rpl	
21	IP-172.16.3.1	IP-172.16.4.99	118	13:36:43.773474	PING Req	
22	IP-172.16.4.99	IP-172.16.3.1	118	13:36:43.774027	PING Rpl	
23	IP-172.16.3.1	IP-172.16.4.99	118	13:36:43.808403	PING Req	

Save Contents

EtherPeek

EtherPeek Demo - Novell NE2000 Adapter - [Packet #5]

File Edit Capture Send Options Statistics Special Tools Window Help

Flags: 0x00
Status: 0x00
Packet Length: 64
Timestamp: 13:36:29.357983 08/25/2000

Ethernet Header
Destination: FF:FF:FF:FF:FF:FF Ethernet Broadcast
Source: 00:10:7B:3B:F8:C0
Protocol Type: 0x0806 IP ARP

ARP - Address Resolution Protocol
Hardware: 1 Ethernet (10/2)
Protocol: 0x0800 IP
Hardware Address Length: 6
Protocol Address Length: 4
Operation: 2 ARP Response
Sender Hardware Address: 00:10:7B:3B:F8:C0
Sender Internet Address: 172.16.2.1
Target Hardware Address: FF:FF:FF:FF:FF:FF Ethernet Broadcast
Target Internet Address: 172.16.2.1
Extra Bytes (Padding):
Data: (18 bytes)
Frame Check Sequence: 0x00000000

```

0: FF FF FF FF FF FF 00 10 7B 3B F8 C0 08 06 00 01 .....(f.....
10: 08 00 06 04 00 02 00 10 7B 3B F8 C0 AC 10 02 01 .....(f.....
20: FF FF FF FF FF FF AC 10 02 01 00 00 00 00 00 00 .....
30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
  
```

Prev Next

Configuring Logging

By default all logging output goes to the console. To have logging output go to a telnet virtual terminal session use the command



TERMINAL MONITOR

```
cisco4#config t
Enter configuration commands, one per line.  End with CNTL/Z.
cisco4(config)#
cisco4(config)#logging ?
  Hostname or A.B.C.D  IP address of the logging host
  buffered             Set buffered logging parameters
  console             Set console logging level
  facility             Facility parameter for syslog messages
  monitor             Set terminal line (monitor) logging level
  on                  Enable logging to all supported destinations
  source-interface    Specify interface for source address in logging
                     transactions
  trap               Set syslog server logging level

cisco4(config)#logging console ?
  alerts             Immediate action needed
  critical           Critical conditions
  debugging          Debugging messages
  emergencies        System is unusable
  errors             Error conditions
  informational      Informational messages
  notifications      Normal but significant conditions
  warnings           Warning conditions
  <cr>

cisco4(config)#logging trap ?
  alerts             Immediate action needed
  critical           Critical conditions
  debugging          Debugging messages
  emergencies        System is unusable
  errors             Error conditions
  informational      Informational messages
  notifications      Normal but significant conditions
  warnings           Warning conditions
  <cr>

cisco4(config)#logging buffered ?
<4096-2147483647>  Logging buffer size
  alerts             Immediate action needed
  critical           Critical conditions
  debugging          Debugging messages
  emergencies        System is unusable
  errors             Error conditions
  informational      Informational messages
  notifications      Normal but significant conditions
  warnings           Warning conditions
  <cr>
```



```
cisco4(config)#logging 172.16.3.99
cisco4(config)#logging trap notifications
cisco4(config)#logging console debugging
cisco4(config)#logging buffered

cisco4#config t
Enter configuration commands, one per line.  End with CNTL/Z.
cisco4(config)#
cisco4(config)#service timestamp ?
    debug    Timestamp debug messages
    log      Timestamp log messages
    <cr>

cisco4(config)#service timestamp debug ?
    datetime  Timestamp with date and time
    uptime    Timestamp with system uptime
    <cr>

cisco4(config)#service timestamp debug datetime ?
    localtime Use local time zone for timestamps
    msec       Include milliseconds in timestamp
    show-timezone Add time zone information to timestamp
    <cr>

cisco4(config)#service timestamp debug datetime msec ?
    localtime Use local time zone for timestamps
    show-timezone Add time zone information to timestamp
    <cr>

cisco4(config)#service timestamp debug datetime msec localtime
cisco4(config)#
cisco4(config)#service timestamp log datetime msec localtime
cisco4(config)#
cisco4(config)#^Z
cisco4#
*Mar  1 00:22:30.377: %SYS-5-CONFIG_I: Configured from console by
console
cisco4(config)#^Z
cisco4#
cisco4#
cisco4#show logging
Syslog logging: enabled (0 messages dropped, 0 flushes, 0 overruns)
  Console logging: level debugging, 32 messages logged
  Monitor logging: level debugging, 0 messages logged
  Buffer logging: level debugging, 1 messages logged
  Trap logging: level notifications, 36 message lines logged
    Logging to 172.16.3.99, 20 message lines logged

Log Buffer (4096 bytes):

*Mar  1 00:48:25.210: %SYS-5-CONFIG_I: Configured from console by
console

cisco4#
cisco4#show run
Building configuration...
```


Current configuration:

```
!  
version 12.0  
service timestamps debug datetime msec localtime  
service timestamps log datetime msec localtime  
no service password-encryption  
!  
hostname cisco4  
!  
enable secret 5 $1$/i3H$WFMLXvu2xXrq6o/xMjZp7/  
enable password 12345  
!  
ip subnet-zero  
!  
!  
!  
interface Ethernet0  
 ip address 172.16.3.1 255.255.255.0  
 no ip directed-broadcast  
!  
interface Serial0  
 no ip address  
  
cisco4#  
cisco4#
```


Ping and Traceroute commands

Ping and Traceroute have two forms of the command:

Standard ping and traceroute which can be executed in both the user exec and the privileged modes.

Extended ping and traceroute which can be executed in the privileged mode only.

Standard PING:

```
cisco2#ping 172.16.4.99
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.4.99, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/34/36 ms
cisco2#
```

Standard TRACEROUTE:

```
cisco2#traceroute 172.16.4.99

Type escape sequence to abort.
Tracing the route to 172.16.4.99

 1 172.16.3.2 20 msec 36 msec 20 msec
 2 172.16.4.99 20 msec 20 msec 16 msec
```

Extended PING:

```
cisco2#ping
Protocol [ip]: ip
Target IP address: 172.16.4.99
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface:
Type of service [0]:
Set DF bit in IP header? [no]: y
Validate reply data? [no]: y
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]: r
Number of hops [ 9 ]:
Loose, Strict, Record, Timestamp, Verbose[RV]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.4.99, timeout is 2 seconds:
Packet has IP options: Total option bytes= 39, padded length=40
  Record route: <*> 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
                   0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0

Reply to request 0 (332 ms). Received packet has options
```



```
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 172.16.4.1 172.16.4.99 172.16.3.2
               172.16.3.1 <*> 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list
```

```
Reply to request 1 (40 ms). Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 172.16.4.1 172.16.4.99 172.16.3.2
               172.16.3.1 <*> 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list
```

```
Reply to request 2 (40 ms). Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 172.16.4.1 172.16.4.99 172.16.3.2
               172.16.3.1 <*> 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list
```

```
Reply to request 3 (40 ms). Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 172.16.4.1 172.16.4.99 172.16.3.2
               172.16.3.1 <*> 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list
```

```
Reply to request 4 (40 ms). Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 172.16.4.1 172.16.4.99 172.16.3.2
               172.16.3.1 <*> 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/98/332
ms
cisco2#
```

Extended TRACEROUTE:

```
cisco2#
cisco2#traceroute
Protocol [ip]: ip
Target IP address: 172.16.4.99
Source address:
Numeric display [n]: y
Timeout in seconds [3]:
Probe count [3]:
Minimum Time to Live [1]:
Maximum Time to Live [30]:
Port Number [33434]:
Loose, Strict, Record, Timestamp, Verbose[none]: r
Number of hops [ 9 ]:
Loose, Strict, Record, Timestamp, Verbose[RV]:
Type escape sequence to abort.
Tracing the route to 172.16.4.99

 1 172.16.3.2 28 msec
Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 <*> 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
               0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list
```



```

40 msec
Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 <*> 0.0.0.0 0.0.0.0 0.0.0.0
               0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list
32 msec
Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 <*> 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
               0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list

2 172.16.4.99 32 msec
Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 172.16.4.1 <*> 0.0.0.0 0.0.0.0
               0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list
36 msec
Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 172.16.4.1 <*> 0.0.0.0 0.0.0.0
               0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list
32 msec
Received packet has options
Total option bytes= 40, padded length=40
Record route: 172.16.3.1 172.16.4.1 <*> 0.0.0.0 0.0.0.0
               0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0 0.0.0.0
End of list

```

Configuring ARP Encapsulation Type and Timeout

```

cisco4#config t
Enter configuration commands, one per line. End with CNTL/Z.
cisco4(config)#int ethernet 0
cisco4(config-if)#
cisco4(config-if)#arp ?

```

```

  arpa          Standard arp protocol
  frame-relay   Enable ARP for a frame relay interface
  probe         HP style arp protocol
  snap          IEEE 802.3 style arp
  timeout       Set ARP cache timeout

```

*arp timeout 0
↓
(never expired)*

```

cisco4(config-if)#arp arpa
cisco4(config-if)#
cisco4(config-if)#arp timeout ?
<0-4294967> Seconds

```

Note that arp timeout of 0 means that the arp cache will never expire !!

```

cisco4(config-if)#arp timeout 600

```

```

cisco4#
cisco4#show arp

```



```

Protocol  Address          Age (min)  Hardware Addr  Type   Interface
Internet  172.16.4.1             -          0050.7321.def5  ARPA   Ethernet0
Internet  172.16.4.99             2          0040.051a.f622  ARPA   Ethernet0
cisco4#
cisco4#show int e0
Ethernet0 is up, line protocol is up
  Hardware is QUICC Ethernet, address is 0050.7321.def5 (bia
0050.7321.def5)
  Internet address is 172.16.4.1/24
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 255/255, load
1/255
  Encapsulation ARPA, loopback not set, keepalive set (10 sec)
  ARP type: ARPA, ARP Timeout 00:10:00
  Last input 00:00:00, output 00:00:08, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 1/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    177 packets input, 28667 bytes, 0 no buffer
    Received 172 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    0 input packets with dribble condition detected
    212 packets output, 21726 bytes, 0 underruns
    0 output errors, 0 collisions, 2 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out
cisco4#

```

CLEAR COMMANDS

```

cisco4#clear ?
  access-list      Clear access list statistical information
  access-template  Access-template
  arp-cache        Clear the entire ARP cache
  bridge           Reset bridge forwarding cache
  cdp              Reset cdp information
  counters         Clear counters on one or all interfaces
  dialer           Clear dialer statistics
  frame-relay-inarp Clear inverse ARP entries from the map table
  host             Delete host table entries
  interface        Clear the hardware logic on an interface
  ip              IP
  ipx             Reset Novell/IPX information
  line            Reset a terminal line
  logging          Clear logging buffer
  snapshot         Clear Snapshot timers
  tcp             Clear a TCP connection or statistics
  x25             Clear X.25 circuits
  xot             Clear an XOT (X.25-Over-TCP) VC

```



```

cisco4#clear counters ?
Ethernet IEEE 802.3
Line Terminal line
Loopback Loopback interface
Null Null interface
Serial Serial
<cr>

cisco4#clear dialer ?
interface Clear dialer information on one interface
<cr>

cisco4#clear ip ?
access-list Clear access list statistical information
access-template Access-template
accounting Clear IP accounting database
cache Delete cache table entries
eigrp Clear IP-EIGRP
nat Clear NAT
nhdp NHRP cache
ospf OSPF clear commands
prefix-list Prefix-list
redirect Redirect cache
route Delete route table entries
rtp RTP/UDP/IP header-compression statistics

cisco4#clear ip route ?
* Delete all routes
A.B.C.D Destination network route to delete

cisco4#
cisco4#clear ipx ?
accounting Clear IPX accounting database
cache Clear IPX fast switching cache
eigrp Clear NOVELL-EIGRP
route Remove IPX routing table entry
spx-spoof Clear IPX SPX Spoof table

cisco4#clear ipx route ?
* Delete routes to all IPX networks
<1-FFFFFFFE> Delete routes to a specific IPX network
default Delete default route

```

```

cisco4#
cisco4#

```

some of the more common uses of the clear commands are:

clear logging (to clear out old logging data)

clear dialer (to clear dialer info and stats)

clear counters ethernet0 (to clear interface stats and counters to get a fresh look for T/S)
serial0

clear arp-cache (to clear an old or invalid arp entry from the cache for T/S)

clear ip route * (to clear the **entire** route table so new updates will refresh the route table)

Following are some examples:

Clear Logging example:

```
cisco4#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Cisco4(config)#
cisco4(config)#logging buffered
cisco4(config)#service timestamps log datetime msec localtime
cisco4(config)#
cisco4(config)#int loopback0
cisco4(config-if)#ip address 172.16.15.1 255.255.255.0
cisco4(config-if)#
cisco4(config-if)#^Z
cisco4#
*Mar 1 00:44:18.333: %SYS-5-CONFIG_I: Configured from console by
console
cisco4#
cisco4#show logging
Syslog logging: enabled (0 messages dropped, 0 flushes, 0 overruns)
  Console logging: level debugging, 19 messages logged
  Monitor logging: level debugging, 0 messages logged
  Buffer logging: level debugging, 1 messages logged
  Trap logging: level informational, 23 message lines logged
```

Log Buffer (4096 bytes):

```
*Mar 1 00:44:18.333: %SYS-5-CONFIG_I: Configured from console by
console
cisco4#
cisco4#config t
Enter configuration commands, one per line.  End with CNTL/Z.
cisco4(config)#
cisco4(config)#int loopback0
cisco4(config-if)#shutdown (Administrative without)
cisco4(config-if)#
*Mar 1 00:45:10.504: %LINK-5-CHANGED: Interface Loopback0, changed
state to administratively down
cisco4(config-if)#
cisco4(config-if)#no shutdown
cisco4(config-if)#
*Mar 1 00:45:25.729: %LINK-3-UPDOWN: Interface Loopback0, changed
state to up
cisco4(config-if)#
*Mar 1 00:45:26.721: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Loopback0, changed state to up
cisco4(config-if)#
cisco4(config-if)#^Z
cisco4#
*Mar 1 00:45:34.939: %SYS-5-CONFIG_I: Configured from console by
console
cisco4#
```



```
cisco4#show logging
```

```
Syslog logging: enabled (0 messages dropped, 0 flushes, 0 overruns)
  Console logging: level debugging, 23 messages logged
  Monitor logging: level debugging, 0 messages logged
  Buffer logging: level debugging, 5 messages logged
  Trap logging: level informational, 27 message lines logged
```

```
Log Buffer (4096 bytes):
```

```
*Mar  1 00:44:18.333: %SYS-5-CONFIG_I: Configured from console by
console
*Mar  1 00:45:10.504: %LINK-5-CHANGED: Interface Loopback0, changed
state to administratively down
*Mar  1 00:45:25.729: %LINK-3-UPDOWN: Interface Loopback0, changed
state to up
*Mar  1 00:45:26.721: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Loopback0, changed state to up
*Mar  1 00:45:34.939: %SYS-5-CONFIG_I: Configured from console by
console
```

```
cisco4#
```

```
cisco4#clear logging
```

```
Clear logging buffer [confirm]y
```

```
cisco4#
```

```
cisco4#show logging
```

```
Syslog logging: enabled (0 messages dropped, 0 flushes, 0 overruns)
  Console logging: level debugging, 23 messages logged
  Monitor logging: level debugging, 0 messages logged
  Buffer logging: level debugging, 5 messages logged
  Trap logging: level informational, 27 message lines logged
```

```
Log Buffer (4096 bytes):
```

```
cisco4#
```

```
cisco4#
```

Clear Counters Example:

```
cisco4#show interface ethernet0
```

```
Ethernet0 is up, line protocol is up
```

```
Hardware is QUICC Ethernet, address is 0050.7321.def5 (bia
0050.7321.def5)
```

```
Internet address is 172.16.4.1/24
```

```
MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 255/255, load
1/255
```

```
Encapsulation ARPA, loopback not set, keepalive set (10 sec)
```

```
ARP type: ARPA, ARP Timeout 04:00:00
```

```
Last input 00:00:05, output 00:00:02, output hang never
```

```
Last clearing of "show interface" counters never
```

```
Queueing strategy: fifo
```

```
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
```

```
5 minute input rate 0 bits/sec, 0 packets/sec
```

```
5 minute output rate 0 bits/sec, 0 packets/sec
```

```
626 packets input, 96849 bytes, 0 no buffer
```

```
Received 583 broadcasts, 0 runts, 0 giants, 0 throttles
```

```
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
```

```
0 input packets with dribble condition detected
```



```

634 packets output, 61246 bytes, 0 underruns
1 output errors, 0 collisions, 7 interface resets
0 babbles, 0 late collision, 0 deferred
1 lost carrier, 0 no carrier
0 output buffer failures, 0 output buffers swapped out
cisco4#
cisco4#clear counters ethernet0
Clear "show interface" counters on this interface [confirm]y
cisco4#

cisco4#show interface ethernet0
Ethernet0 is up, line protocol is up
  Hardware is QUICC Ethernet, address is 0050.7321.def5 (bia
0050.7321.def5)
  Internet address is 172.16.4.1/24
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 255/255, load
1/255
  Encapsulation ARPA, loopback not set, keepalive set (10 sec)
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:11, output 00:00:00, output hang never
Last clearing of "show interface" counters 00:00:16
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    2 packets input, 220 bytes, 0 no buffer
    Received 2 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    0 input packets with dribble condition detected
    3 packets output, 226 bytes, 0 underruns
    0 output errors, 0 collisions, 0 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out

```

Clear arp-cache Example:

```

cisco4#
cisco4#show arp
Protocol Address           Age (min)  Hardware Addr  Type   Interface
Internet 172.16.4.1                -           0050.7321.def5 ARPA    Ethernet0
Internet 172.16.4.99        12          0040.051a.f622 ARPA    Ethernet0
cisco4#
cisco4#debug arp
ARP packet debugging is on
cisco4#
cisco4#clear arp-cache
cisco4#
*Mar  1 01:14:11.714: IP ARP: sent req src 172.16.4.1 0050.7321.def5,
                        dst 172.16.4.99 0040.051a.f622 Ethernet0
*Mar  1 01:14:11.726: IP ARP: sent rep src 172.16.4.1 0050.7321.def5,
                        dst 172.16.4.1 ffff.ffff.ffff Ethernet0
*Mar  1 01:14:11.738: IP ARP: rcvd rep src 172.16.4.99 0040.051a.f622,
dst 172.16.4.1 Ethernet0
*Mar  1 01:14:11.742: IP ARP: creating entry for IP address:
172.16.4.99, hw: 0040.051a.f622

```



```

cisco4#
cisco4#show arp
Protocol  Address             Age (min)  Hardware Addr  Type   Interface
Internet  172.16.4.1                -          0050.7321.def5  ARPA   Ethernet0
Internet  172.16.4.99          0          0040.051a.f622  ARPA   Ethernet0
cisco4#
cisco4#

```

Clear ip route Example:

```

cisco4#
cisco4#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B' -
BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate
default
        U - per-user static route, o - ODR
        T - traffic engineered route

```

Gateway of last resort is not set

```

        172.16.0.0/24 is subnetted, 4 subnets
C       172.16.15.0 is directly connected, Loopback0
C       172.16.4.0 is directly connected, Ethernet0
R       172.16.2.0 [120/1] via 172.16.3.1, 00:00:12, Serial0
C       172.16.3.0 is directly connected, Serial0

```

```

cisco4#
cisco4#show ip route 172.16.2.0
Routing entry for 172.16.2.0/24
  Known via "rip", distance 120, metric 1
  Redistributing via rip
  Advertised by rip (self originated)
  Last update from 172.16.3.1 on Serial0, 00:00:24 ago
  Routing Descriptor Blocks:
    * 172.16.3.1, from 172.16.3.1, 00:00:24 ago, via Serial0
      Route metric is 1, traffic share count is 1

```

```

cisco4#
cisco4#clear ip route 172.16.2.0
cisco4#
cisco4#show ip route 172.16.2.0
% Subnet not in table

```

Notice that it takes RIP a while to update the cleared route

```

cisco4#show ip route 172.16.2.0
% Subnet not in table

```

```

cisco4#show ip route 172.16.2.0
Routing entry for 172.16.2.0/24
  Known via "rip", distance 120, metric 1
  Redistributing via rip

```



```

Advertised by rip (self originated)
Last update from 172.16.3.1 on Serial0, 00:00:06 ago
Routing Descriptor Blocks:
* 172.16.3.1, from 172.16.3.1, 00:00:06 ago, via Serial0
  Route metric is 1, traffic share count is 1

```

```
cisco4#
```

Configuring and Viewing Switching Methods

```

cisco4#config t
Enter configuration commands, one per line.  End with CNTL/Z.
cisco4(config)#int ethernet 0
cisco4(config-if)#
cisco4(config-if)#ip ?
Interface IP configuration subcommands:
  access-group      Specify access control for packets
  accounting         Enable IP accounting on this interface
  address           Set the IP address of an interface
  authentication     authentication subcommands
  bandwidth-percent Set EIGRP bandwidth limit
  broadcast-address  Set the broadcast address of an interface
  directed-broadcast Enable forwarding of directed broadcasts
  hello-interval     Configures IP-EIGRP hello interval
  helper-address     Specify a destination address for UDP broadcasts
  hold-time          Configures IP-EIGRP hold time
  irdp              ICMP Router Discovery Protocol
  mask-reply         Enable sending ICMP Mask Reply messages
  mobile            Mobile Host Protocol
  mtu               Set IP Maximum Transmission Unit
  nat               NAT interface commands
  nhrp              NHRP interface subcommands
  ospf              OSPF interface commands
  policy            Enable policy routing
  probe             Enable HP Probe support
  proxy-arp         Enable proxy ARP
  rarp-server        Enable RARP server for static arp entries
  redirects          Enable sending ICMP Redirect messages
  rip               Router Information Protocol
  route-cache        Enable fast-switching cache for outgoing packets
  rtp               RTP parameters
  security           DDN IP Security Option
  split-horizon      Perform split horizon
  summary-address    Perform address summarization
  tcp               TCP header compression parameters
  unnumbered         Enable IP processing without an explicit address
  unreachable        Enable sending ICMP Unreachable messages
  verify             Enable per packet validation

```

```

cisco4(config-if)#ip route-cache
cisco4(config-if)#

```



```

cisco4#show ip int e0
Ethernet0 is up, line protocol is up
  Internet address is 172.16.4.1/24
  Broadcast address is 255.255.255.255
  Address determined by non-volatile memory
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  Multicast reserved groups joined: 224.0.0.9
  Outgoing access list is not set
  Inbound access list is not set
  Proxy ARP is enabled
  Security level is default
  Split horizon is enabled
  ICMP redirects are always sent
  ICMP unreachable are always sent
  ICMP mask replies are never sent
  IP fast switching is enabled
  IP fast switching on the same interface is disabled
  IP Fast switching turbo vector
  IP multicast fast switching is disabled
  IP multicast distributed fast switching is disabled
  Router Discovery is disabled
  IP output packet accounting is disabled
  IP access violation accounting is disabled
  TCP/IP header compression is disabled
  RTP/IP header compression is disabled
  Probe proxy name replies are disabled
  Policy routing is disabled
  Network address translation is disabled
  Web Cache Redirect is disabled
  BGP Policy Mapping is disabled

```

```
cisco4#
```

```
cisco4#show interface stats
```

```
Ethernet0
```

Switching path	Pkts In	Chars In	Pkts Out	Chars Out
Processor	278	45079	333	32860
Route cache	0	0	0	0
Total	278	45079	333	32860

```
Serial0
```

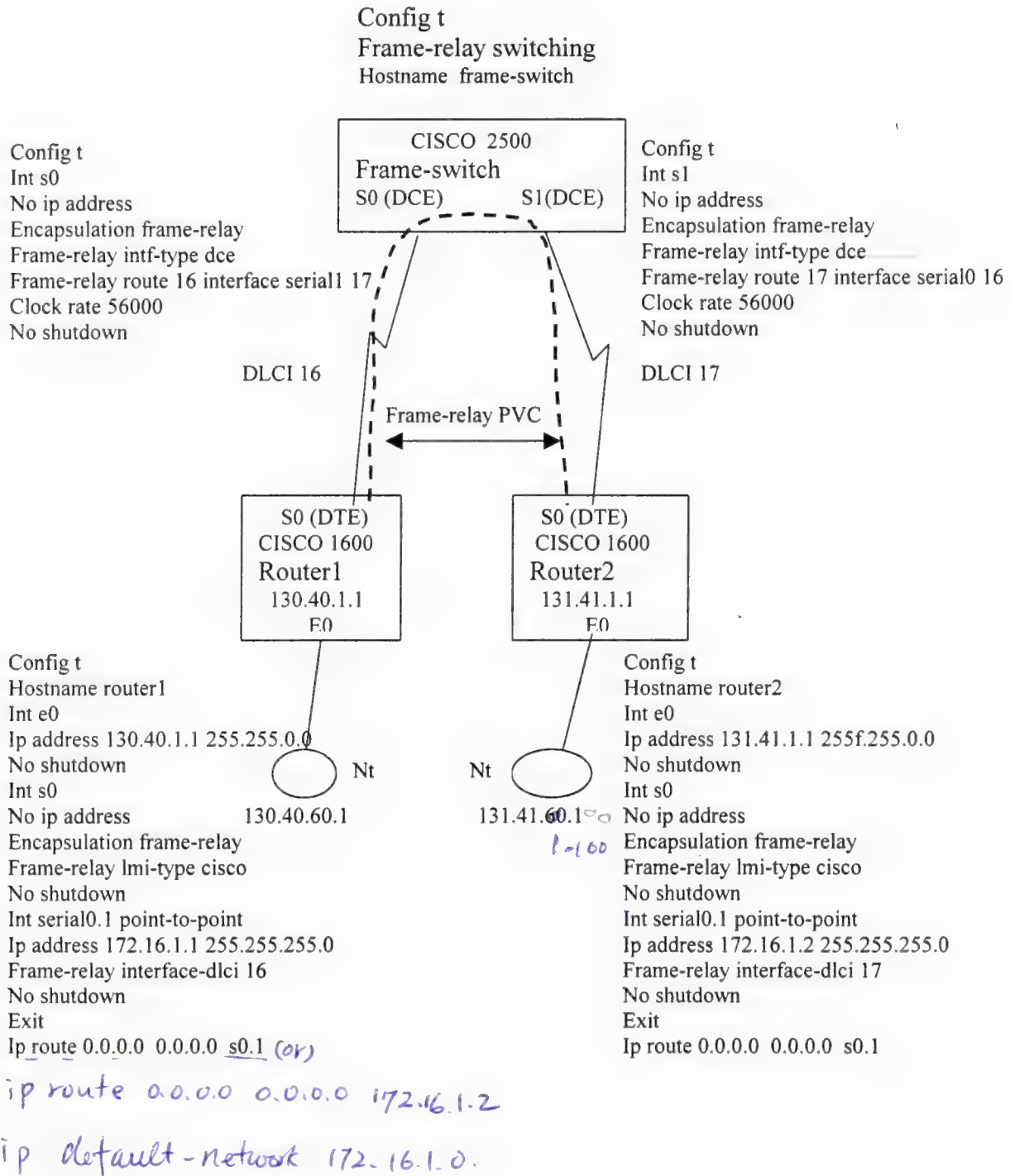
Switching path	Pkts In	Chars In	Pkts Out	Chars Out
Processor	341	22171	330	21732
Route cache	0	0	0	0
Total	341	22171	330	21732

```
cisco4#
```

```
cisco4#
```


Frame Relay configuration example

One Cisco 2500 series router will act as a frame relay switch and simulate the "frame relay cloud". The other two routers will be frame relay client routers with an Nt client attached. When working the two client pc's should be able to ping each other and map drives.



Frame relay switch configuration

```
frame-switch#show run
Building configuration...
```

```
Current configuration:
```

```
!
version 11.2
!
hostname frame-switch
!
enable secret 5 $1$J/qE$wokIto2s4718DcCFcnpx0
enable password 12345
!
frame-relay switching
!
interface Ethernet0
  no ip address
  shutdown
!
interface Ethernet1
  no ip address
  shutdown
!
interface Serial0
  no ip address
  encapsulation frame-relay
  clockrate 56000
  frame-relay intf-type dce
  frame-relay route 16 interface Serial1 17
!
interface Serial1
  no ip address
  encapsulation frame-relay
  clockrate 56000
  frame-relay intf-type dce
  frame-relay route 17 interface Serial0 16
!
no ip classless
!
line con 0
line aux 0
line vty 0 4
  password 12345
  login
!
end
```



```

frame-switch#
frame-switch#show int s0
Serial0 is up, line protocol is up
  Hardware is HD64570
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load
  1/255
  Encapsulation FRAME-RELAY, loopback not set, keepalive set (10 sec)
  LMI enq sent 2, LMI stat recvd 0, LMI upd recvd 0
  LMI enq recvd 132, LMI stat sent 132, LMI upd sent 0, DCE LMI up
  LMI DLCI 1023 LMI type is CISCO frame relay DCE
  Broadcast queue 0/64, broadcasts sent/dropped 0/0, interface
  broadcasts 0
  Last input 00:00:02, output 00:00:02, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/64/0 (size/threshold/drops)
    Conversations 0/1 (active/max active)
    Reserved Conversations 0/0 (allocated/max allocated)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    215 packets input, 14780 bytes, 0 no buffer
    Received 0 broadcasts, 0 runts, 0 giants
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    185 packets output, 10885 bytes, 0 underruns
    0 output errors, 0 collisions, 50 interface resets
    0 output buffer failures, 0 output buffers swapped out
    39 carrier transitions
    DCD=up DSR=up DTR=up RTS=up CTS=up
frame-switch#
frame-switch#show int s1
Serial1 is up, line protocol is up
  Hardware is HD64570
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load
  1/255
  Encapsulation FRAME-RELAY, loopback not set, keepalive set (10 sec)
  LMI enq sent 1, LMI stat recvd 0, LMI upd recvd 0
  LMI enq recvd 164, LMI stat sent 162, LMI upd sent 0, DCE LMI up
  LMI DLCI 1023 LMI type is CISCO frame relay DCE
  Broadcast queue 0/64, broadcasts sent/dropped 0/0, interface
  broadcasts 0
  Last input 00:00:02, output 00:00:02, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/64/0 (size/threshold/drops)
    Conversations 0/2 (active/max active)
    Reserved Conversations 0/0 (allocated/max allocated)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    249 packets input, 16058 bytes, 0 no buffer
    Received 0 broadcasts, 0 runts, 0 giants
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    248 packets output, 16688 bytes, 0 underruns
    0 output errors, 0 collisions, 17 interface resets
    0 output buffer failures, 0 output buffers swapped out

```



```

frame-switch#
frame-switch#show frame-relay ?
  ip      show frame relay IP statistics
  lapf    show frame relay lapf status/statistics
  lmi     show frame relay lmi statistics
  map     Frame-Relay map table
  pvc     show frame relay pvc statistics
  route   show frame relay route
  svc     show frame relay SVC stuff
  traffic Frame-Relay protocol statistics

```

```
frame-switch#show frame-relay lmi
```

LMI Statistics for interface Serial0 (Frame Relay DCE) LMI TYPE = CISCO

Invalid Unnumbered info 0	Invalid Prot Disc 0
Invalid dummy Call Ref 0	Invalid Msg Type 0
Invalid Status Message 0	Invalid Lock Shift 0
Invalid Information ID 0	Invalid Report IE Len 0
Invalid Report Request 0	Invalid Keep IE Len 0
Num Status Enq. Rcvd 135	Num Status msgs Sent 135
Num Update Status Sent 0	Num St Enq. Timeouts 46

LMI Statistics for interface Serial1 (Frame Relay DCE) LMI TYPE = CISCO

Invalid Unnumbered info 0	Invalid Prot Disc 0
Invalid dummy Call Ref 0	Invalid Msg Type 0
Invalid Status Message 0	Invalid Lock Shift 0
Invalid Information ID 2	Invalid Report IE Len 0
Invalid Report Request 0	Invalid Keep IE Len 0
Num Status Enq. Rcvd 166	Num Status msgs Sent 164
Num Update Status Sent 0	Num St Enq. Timeouts 3

```

frame-switch#
frame-switch#show frame-relay pvc

```

PVC Statistics for interface Serial0 (Frame Relay DCE)

DLCI = 16, DLCI USAGE = SWITCHED, PVC STATUS = ACTIVE, INTERFACE = Serial0

input pkts 54	output pkts 54	in bytes 9610
out bytes 9263	dropped pkts 0	in FECN pkts 0
in BECN pkts 0	out FECN pkts 0	out BECN pkts 0
in DE pkts 0	out DE pkts 0	
pvc create time 00:33:35, last time pvc status changed 00:13:57		
Num Pkts Switched 54		

PVC Statistics for interface Serial1 (Frame Relay DCE)

DLCI = 17, DLCI USAGE = SWITCHED, PVC STATUS = ACTIVE, INTERFACE = Serial1

input pkts 55	output pkts 54	in bytes 9557
out bytes 9610	dropped pkts 1	in FECN pkts 0
in BECN pkts 0	out FECN pkts 0	out BECN pkts 0
in DE pkts 0	out DE pkts 0	
pvc create time 00:32:19, last time pvc status changed 00:22:21		
Num Pkts Switched 54		


```
frame-switch#
```

```
frame-switch#
frame-switch#show frame-relay route
```

Input Intf	Input Dlci	Output Intf	Output Dlci	Status
Serial0	16	Serial1	17	active
Serial1	17	Serial0	16	active

```
frame-switch#
```

BECN, FECN, and DE statistics can indicate frame-relay congestion.

BECN - Backwards Explicit Congestion Notification. Congestion on network in the direction opposite of which frames were travelling.

FECN - Forward Explicit Congestion Notification. Congestion en route to destination.

DE - Discard Eligibility Bit. Frame can be dropped if network is congested.

Frame Relay Debug commands :

```
debug frame-relay packet
debug frame-relay lmi
debug frame-relay events
```

The following is one of the frame relay client router configurations

```
router2#show run
Building configuration...
```

```
Current configuration:
```

```
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname router2
!
enable secret 5 $1$6/10$upCzhjwEEiqAaYQhWFqfd/
enable password 12345
!
ip subnet-zero
!
interface Ethernet0
 ip address 131.41.1.1 255.255.0.0
 no ip directed-broadcast
!
interface Serial0
 no ip address
 no ip directed-broadcast
```



```

encapsulation frame-relay
frame-relay lmi-type cisco
!
interface Serial0.1 point-to-point
ip address 172.16.1.2 255.255.255.0
no ip directed-broadcast
frame-relay interface-dlci 17
!
ip classless
ip route 0.0.0.0 0.0.0.0 Serial0.1
!
!
line con 0
transport input none
line 1
line vty 0 4
password 12345
login
!
end

```

```

router2#
router2#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate
default
        U - per-user static route, o - ODR
        T - traffic engineered route

```

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

```

        172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial0.1
C       131.41.0.0/16 is directly connected, Ethernet0
S*    0.0.0.0/0 is directly connected, Serial0.1

```

```

router2#
router2#
router2#show int s0
Serial0 is up, line protocol is up
  Hardware is QUICC Serial
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load
  1/255
  Encapsulation FRAME-RELAY, loopback not set, keepalive set (10 sec)
  LMI enq sent 112, LMI stat recvd 112, LMI upd recvd 0, DTE LMI up
  LMI enq recvd 0, LMI stat sent 0, LMI upd sent 0
  LMI DLCI 1023 LMI type is CISCO frame relay DTE
  Broadcast queue 0/64, broadcasts sent/dropped 19/0, interface
  broadcasts 0
  Last input 00:00:07, output 00:00:07, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair

```

never issues the clear counters comments


```

Output queue: 0/1000/64/0 (size/max total/threshold/drops)
  Conversations 0/1/256 (active/max active/max total)
  Reserved Conversations 0/0 (allocated/max allocated)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  169 packets input, 11158 bytes, 0 no buffer
  Received 112 broadcasts, 0 runts, 0 giants, 0 throttles
  8 input errors, 0 CRC, 8 frame, 0 overrun, 0 ignored, 0 abort
  196 packets output, 14792 bytes, 0 underruns
  0 output errors, 0 collisions, 18 interface resets
  0 output buffer failures, 0 output buffers swapped out
  0 carrier transitions
DCD=up DSR=up DTR=up RTS=up CTS=up ?

```

```
router2#
```

```
router2#
```

```
router2#show frame-relay ?
```

```

ip                show frame relay IP statistics
lapf              show frame relay lapf status/statistics
lmi               show frame relay lmi statistics
map               Frame-Relay map table
pvc               show frame relay pvc statistics
qos-autosense     show frame relay qos-autosense information
route             show frame relay route
svc               show frame relay SVC stuff
traffic           Frame-Relay protocol statistics

```

```
router2#
```

```
router2#show frame-relay lmi
```

LMI Statistics for interface Serial0 (Frame Relay DTE) LMI TYPE = CISCO

Invalid Unnumbered info 0	Invalid Prot Disc Q
Invalid dummy Call Ref 0	Invalid Msg Type 0
Invalid Status Message 0	Invalid Lock Shift 0
Invalid Information ID 0	Invalid Report IE Len 0
Invalid Report Request 0	Invalid Keep IE Len 0
Num Status Enq. Sent 115	Num Status msgs Rcvd 115
Num Update Status Rcvd 0	Num Status Timeouts 0

```
router2#
```

```
router2#show frame-relay map
```

```

Serial0 (up): ip 0.0.0.0 dlci 17(0x11,0x410)
                broadcast,
                CISCO, status defined, active
Serial0.1 (up): point-to-point dlci, dlci 17(0x11,0x410), broadcast
                status defined, active

```

```
router2#
```

```
router2#show frame-relay pvc
```

PVC Statistics for interface Serial0 (Frame Relay DTE)

```

DLCI = 17, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE =
Serial0.1

```



```

input pkts 56          output pkts 54          in bytes 9248
out bytes 9260         dropped pkts 0        in FECN pkts 0
in BECN pkts 0        out FECN pkts 0      out BECN pkts 0
in DE pkts 0          out DE pkts 0
out bcast pkts 20      out bcast bytes 5880
pvc create time 00:19:21, last time pvc status changed 00:19:21
router2#

```

Notice that router2 can ping router1 thru the frame relay network !!!

```

router2#
router2#ping 130.40.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 130.40.1.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 72/73/76 ms

```

```

router2#
router2#traceroute 130.40.1.1

Type escape sequence to abort.
Tracing the route to 130.40.1.1

```

```

  1 172.16.1.1 40 msec 60 msec *
router2#
router2#

```

Frame Relay Definitions

Frame Relay is a high performance WAN protocol that utilizes the Physical and Data Link Layers of the OSI model. It is a packet switched network that uses PVC's (permanent virtual circuits) and SVC's (switched virtual circuits), but PVC's are more common.

Frame Relay networks are comprised of the following components.

- Carriers Frame Relay network or "cloud" consisting of many frame relay switches.
- **DTE** equipment which is typically a **ROUTER**.
- **DCE** equipment which is typically a **CSU/DSU and switch** located at the service provider.

When configuring Frame Relay on Cisco routers, the first thing to do is to specify frame relay as the serial encapsulation method on the serial interface. **Cisco supports two frame relay encapsulation methods, CISCO and IETF.** CISCO is the default unless you specify IETF. CISCO is a proprietary encapsulation type and is only compatible with other cisco devices, therefore you should use IETF when interconnecting with other vendors equipment.

```

config t
interface serial 0
encapsulation frame-relay [ietf] #cisco is the default unless you specify ietf

```


Frame Relay uses DLCI's (Data Link Connection Identifier) to identify PVC's in a frame relay network. DLCI's have only local significance and can change upon entering the carriers frame relay network.

```
config t
interface serial 0
frame-relay interface-dlci 16
```

Frame Relay also utilizes LMI's (Local Management Interface) which are extensions to the protocol to allow internetwork devices to easily communicate through the frame relay network. LMI's provide information about current DLCI values and the status of virtual circuits. Cisco supports **three LMI types** :

ANSI
CISCO (default)
Q933a

```
Config t
Interface serial 0
Frame-relay lmi-type cisco
                        ansi
                        q933a
```

The LMI type is autodetected in Cisco IOS ver 11.2 and above.

ISDN

- **SPID** 10 digit phone ISDN phone number. SPID initializes layer 3

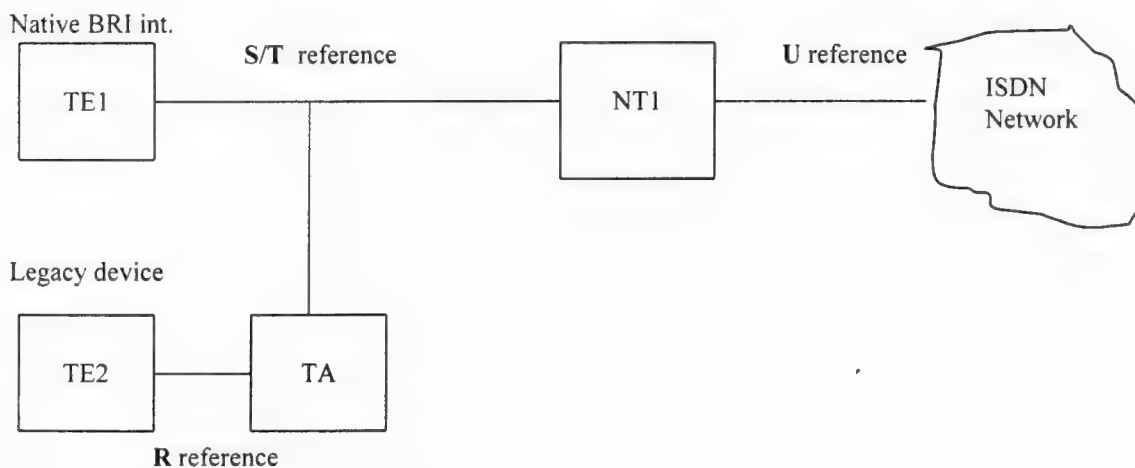
```

Config t
Isdn switch-type basic-dms
                basic-5ess (AT&t)
                basic-nil

int bri 0
encapsulation ppp
isdn spid1 7746566191
isdn spid2 7746566192
  
```

- **q921** Layer 2/data link layer protocol over D channel also known as LAPD
- **q931** Layer 3/network layer protocol over D channel. Provides call setup, teardown, channel allocation
- **show isdn events** displays information about all 3 isdn layers (physical, datalink, network). Displays isdn switch type and can be used to quickly verify isdn status.
- **Show controller bri** displays info about physical layer connectivity, internal controller variables
- **Show dialer interfaces bri** displays info about dialer interface and DDR settings.

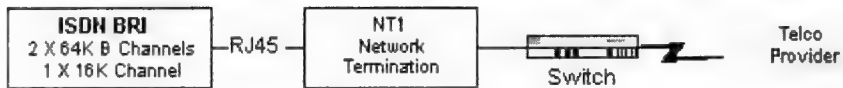
ISDN Reference Points



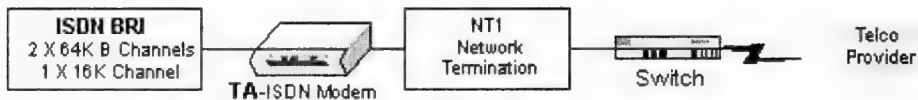
- R reference point is between non-ISDN (TE2) equipment and a TA
- S reference point is between user terminals (TE1) and NT2 devices
- T reference point is between NT1 and NT2 devices
- U reference point is between NT1 devices and line termination equipment at the ISDN carriers network

ISDN**Description and Interfaces:**

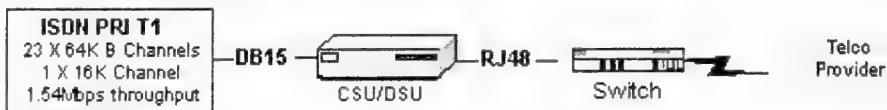
TE1 - Has an ISDN Interface. DS0=64Kbps=Digital Signal Level 0



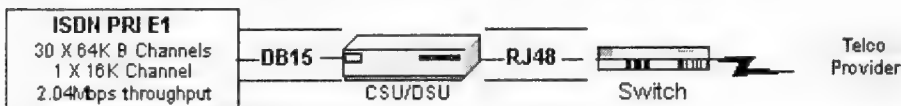
TE2 - Does not have an ISDN interface; requires a TA (Terminal Adapter). The TA is typically an ISDN Modem. The TA converts the signal to ISDN standards. DS0=64Kbps



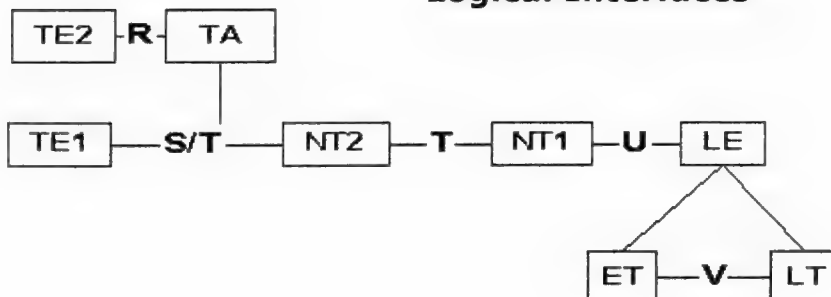
ISDN PRI US T1 - Requires different connectors. Uses DB15 and RJ48 connections. DS1=1.54Mbps contains 24 DS0's



ISDN PRI EUROPE E1 - Requires 4 connections DB15 before the CSU/DSU and 4 RJ45 and/or DB15 connections to the switch. 30 X DS0

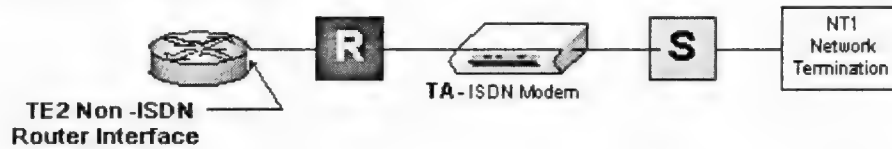


In Europe, the ISDN service provider provides the NT1. In the US, the customer supplies the NT1.

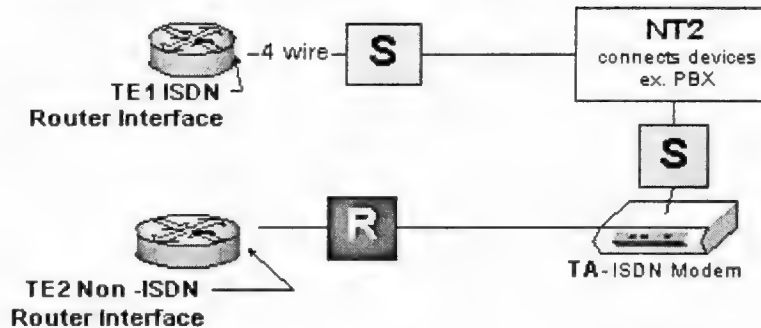
Logical Interfaces

RSTUV-Logical Reference Points

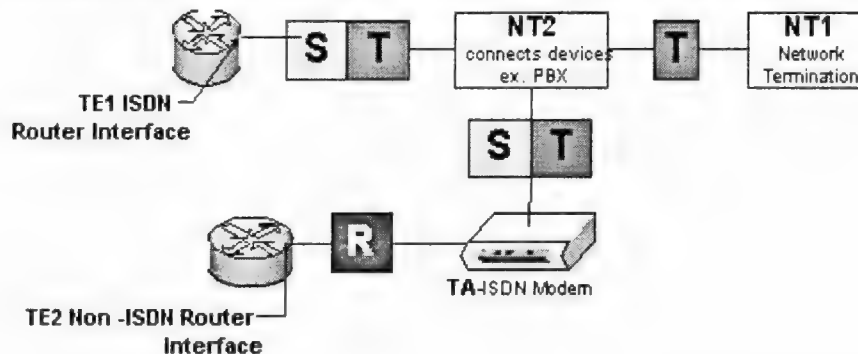
Rate Reference Point - Located between the NON ISDN router interface and the Terminal Adapter (TA).



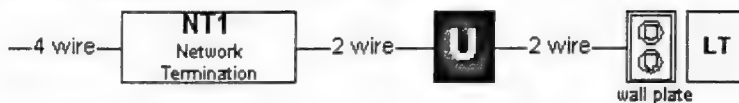
System Reference Point - Is the reference point between the router with an ISDN Interface and the NT2 or TA and NT2. Non-US demarcation.



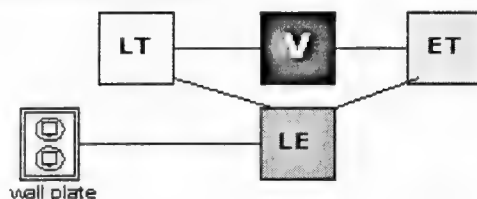
Terminal Reference Point - The reference point between the TE1 and NT1 and/or TA. If there is an NT2 (Customer Switching Equipment), the reference point is included to the NT1 as well. This point is NON-US demarcation.



User Reference Point - This reference point is a US demarcation. It references the point between the NT1 and the LT.



V Reference Point - Located between the LT and the ET. Also referred to as the local exchange.



ISDN Protocols - ITU-T Groups the protocols, interfaces and addressing.

E-series - describes telephone network ex. E.164=International addressing for ISDN.

I-series - describes **Interfaces & Concepts** ex. I.430=BRI Interface.

Q-series - describes switching and signaling. (e.g. Q.921=LAPD Link Access Procedure D channel, Q.931 DSS1 Digital Subscriber Signaling #1)

Configuring ISDN BRI:

1. Select your switch type (provided by your service provider)

- **Router2 (config)# isdn switch-type basic-5ess** (basic-5ess is the switch type)
- **Router2 (config-if)# isdn switch-type basic-5ess** (basic-5ess is the switch type)

2. Configure the appropriate interface on the router.

- **Router2 (config)# interface bri X** (x = the interface you are going to configure)
- *For a TE1 non-ISDN interface use the interface serial command.*
- **Router2 (config)# interface serial X** (x = the interface you are going to configure)

3. Set SPID's (Service Profile Identifiers). The service provider assigns these numbers.

- **Router2 (config-if)# isdn spid1 512790203300**
- **Router2 (config-if)# isdn spid1 512790203400**

4. Set the appropriate protocol for encapsulation and set the protocol for authentication. PPP or HDLC can be used for encapsulation. CHAP or PAP can be used for authentication. CHAP is encrypted; PAP sends information in plain text.

- **Router2 (config-if)# encapsulation ppp**
- **Router2 (config-if)# authentication chap**

Dial on Demand Routing (DDR)

DDR for ISDN - Use DDR for connections that do not need to be connected for long periods of time. Determine what traffic is "interesting" and needs to be routed. Use access lists to restrict broadcasts such as SAP updates and permit traffic that needs to be forwarded. You can also use the **passive interface** command to prevent the forwarding of routing updates ex. IGRP, OSPF

dialer list is the command used to configure DDR. This command is used to first initiate the call and used to control the protocol for dialing.

1. Define what traffic is interesting. An **access-list** command can be used following this **dialer-list** command to specify the appropriate traffic to be forwarded.

- **Router2 (config)# dialer-list 3 protocol ip permit**
- **Router2 (config)# access-list 5 permit protocol ip x.x.x.x any 10.98.98.x any**

2. Assign the dialer-list to the appropriate interface.

- **Router2 (config-if)# interface bri 2**
- **Router2 (config-if)#dialer-group 3** (3= the group number)

3. Assign the destination. Use the **dialer map** command to specify the destination parameters.

- **Router2 (config-if)#dialer map 10.180.0.3 router3 5125551092**

4. Determine which call options to use. To use DDR successfully, you must specify the appropriate call values.

- **Router2 (config-if)# dialer fast-idle 30** (if the interface is busy and another call needs to be placed, 30 specifies to disconnect the call if the line is idle for over 30 seconds)
- **Router2 (config-if)# dialer idle-timeout 180** (tells the interface to disconnect after idle for 180 seconds)
- **Router2 (config-if)# dialer load-threshold 128 either** (1-255 value tells the router at what level to make another call to another destination)

Options can be **inbound**, **outbound** or **either**.

Rate adaptation - The data speed of an ISDN line can be slowed down to 56K if necessary. Use the **speed** option with the **dialer map** command.

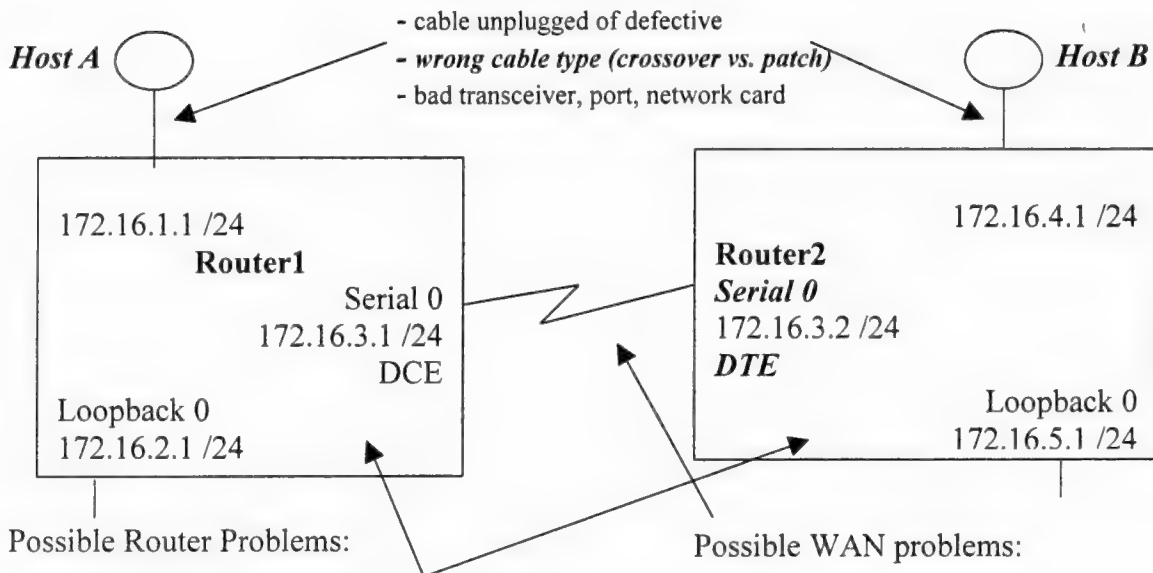
Router2 (config-if)# dialer map 10.180.0.3 router3 5125551092 speed 56 broadcast 5125551038

Discussion Problem: Host A cannot talk to Host B. Ping, Telnet, FTP, etc., all fail.**Possible Host Problems:**

- remote host down
- no ip address (DHCP, BootP)
- duplicate ip address
- incorrect ip address, subnet mask, default gateway
- name resolution problems (DNS, WINS, hosts
lmhosts, ip helper-address on router)

Host T/S Tools:

- ping
- tracert
- ipconfig /all (NT and 98)
- winipcfg (95/98)
- netstat -a , -e, -n, -s, -r
- nbtstat
- route print



T/S commands

show run
show version

ping
tracert

show cdp neighbors
show cdp neighbors detail

show interface
show interface serial0 | e0

show arp
show ip arp

show ip interface
show ip protocol
show ip route
show ip route 172.16.3.0 (ip-address)
show ip traffic

show access-list
show ip access-list

show ip eigrp neighbors
show ip eigrp interfaces
show ip eigrp events
show ip eigrp topology
show ip eigrp traffic

show ip ospf
show ip ospf neighbor
show ip ospf database
show ip ospf database router
show ip ospf border-routers
show ip ospf

show queueing
show queue serial 0

show dialer
show ppp multilink

Debug commands - Go over these commands

show debugging
undebug all
terminal monitor (to send debugging info to a telnet session)

config t
service timestamps debug datetime msec localtime
service timestamps log datetime msec localtime

debug serial interface
debug dialer
debug ppp negotiation
debug ppp authentication
debug ppp chap
debug ppp packet

debug ip rip
debug ip rip events

debug ip eigrp
debug ip eigrp neighbor
debug ip eigrp events
debug ip eigrp summary

debug ip ospf adj
debug ip ospf events
debug ip ospf packet

